FY 2020 INDOT Research Program Summary of IMPACT

Taking INDOT to the Next Level

Impacting INDOT's Strategic Objectives: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology

Introduction: The INDOT/JTRP Research Program is an established state DOT Research Program that has partnered with practioners, academia, and industry since 1937 to address Indiana's transportation needs and challenges. The program has realized significant achievements over the years and each year provides two reports highlighting the quantitative and qualitative benefits delivered by the program. One report is the Return on Investment (ROI) that quantifies the cost savings to customers (user costs and safety) and to INDOT (departmental savings). The second report is the summary of IMPACT that describes the qualitative benefits derived from the program. Together these reports provide a comprehensive snapshot of the many benefits from the INDOT/JTRP Research Program. Many state DOTs have modeled their state research programs after the Indiana program. The program has also received national recognition for its impact on national transportation issues.

In 2019, INDOT unveiled its updated Strategic Plan. Strategic Objectives included: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology. The Research Program provides direct support to the Strategic Plan for INDOT to fulfill its Strategic Objectives outlined in the Strategic Plan.

In 2020 the COVID – 19 pandemic challenged INDOT, the State of Indiana, the country and the world. COVID – 19 affected INDOT Research Program as well, however, INDOT Research & Development adapted with new practices to keep the Research Program functional, efficient, and effective. This summary highlights projects completed in FY 2020. Additional accomplishments are also included such as awards, contributions from specialized testing programs, performance metrics, continuous improvement initiatives, and the relatively new forensic investigation program.

Following, is a listing of IMPACT areas and research projects and activities that resulted in defined benefits to customers and stakeholders.

Strategic Plan Impact Areas:

- Safety & Mobility
- Asset Sustainability
- Innovation & Technology and Economic Competitiveness
- Customer Service and Organization & Workforce

Other Program Impact Areas:

- Engagement & Networking
- State and National Recognitions
- Forensic Investigations and Specialized Testing Programs
- Program Metrics & Venues for Continuous Improvement
- Resources & Links

IMPACT

Your investment is having IMPACT

○ Strategic Plan Impact Areas

These are select examples of projects. Each individual project can be downloaded from https://docs.lib.purdue.edu/jtrp/ for additional information.

- **IMPACT on Safety & Mobility (select examples)**

- **SPR-4103**, Developing the **Collision Diagram** Builder
- **SPR-4126**, Implementation of LiDAR-Based Mobile Mapping System for **Lane Width Evaluation and Reporting in Work Zones**
- **SPR-4160**, Programming of Road Projects During The Construction Season Considering **Network Connectivity**

- **SPR-4205**, **Connected Vehicle Corridor Deployment** and Performance Measures for Assessment
- **SPR-4216**, Statistical Analysis of Safety Improvements and Integration into Project Design Process
- **SPR-4217, Speed Management** in Small Cities and Towns - Guidelines for Indiana
- **SP$-4226,** Cost-Effectiveness of **Converting Signalized Arterials to Free-Flow Facilities**
- **SPR 4305,** Development of **Automated Incident Detection System**
- **SPR-4306**, **Back of Queue Warning** and Critical Information Delivery to Motorists
- **SPR-4318,** Installation and Maintenance of **Raised Pavement Markers** at State Transportation Agencies: Synthesis of Current Practices

- **IMPACT on Asset Sustainability (select examples)**

  - **SPR-3820,** Probability of Detection (POD) Study for **Bridge Inspection** Related to Steel Bridges
  - **SPR-3857**, Assessment of **Pipe** Fill Heights
  - **SPR-3916**, Scour Protection Determination for **Small Culverts**
  - **SPR-4003**, Improving the Quality of Concrete for INDOT Projects

- **SPR-4004,** Development of **Subgrade Stabilization and Slab Undersealing Solutions** for PCC Pavements Restoration and Repairs
- **SPR-4112**, Best Practices for **Patching** Composite Pavements
- **SPR-4114**, Performance **Balanced Mix Design** for Indiana's Asphalt Pavements
- **SPR-4210**, Determining the **Optimal Traffic Opening Timing** through an in-situ NDT Method for Concrete Early Age Properties Monitoring
- **SPR-4321**, Evaluation of Our Current and Other Available **Anti-Icing & De-Icing Products** Under Controlled Environmental Conditions to Test Effectiveness

- **Impact on Innovation & Technology and Economic Competiveness (select examples)**

- **SPR-4162**, Incorporating Economic Resilience into INDOT's Transportation Decision-making
- **SPR-4225**, **INDOT Research Program** Benefit Cost Analysis – Return on Investment (**ROI**)
- **SPR-4228,** Developing **a Business Ecosystem around Autonomous Vehicle Infrastructure in Indiana**
- **SPR-4308,** Investigation of **Strategic Deployment Opportunities for Unmanned Aerial Systems (UAS)**
- **SPR-4319, Cost/Benefit Analysis of Installing Fiber Optics on INDOT Projects**
- **UAS** Applications Implementation.

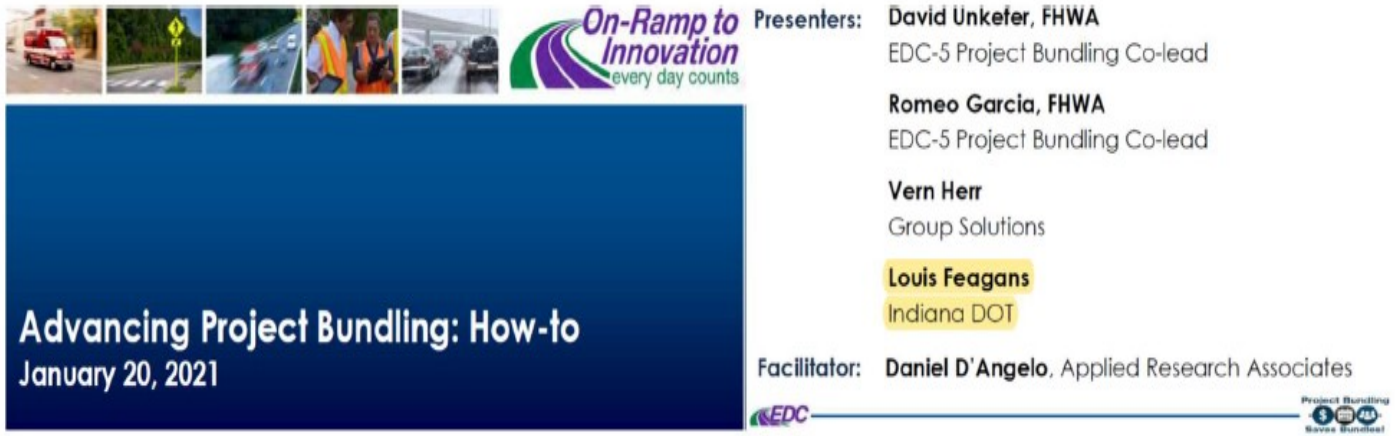
- **IMPACT on Customer Service and Organization & Workforce (select examples)**

  - ***SPR 3715, S-BRITE***, bridge inspection training, certification, other activities
  - **SPR-3852**, Transportation Research Board (**TRB)** Annual Meeting Activities
  - **SPR-4150**, Implementation Proposal for **Improve Energy Efficiency of Facilities**
  - **SPR-4223**, Implementing the Strut-and-Tie Method for **Bridge Design (Training Workshop)**
  - **SPR-4355,** Synthesis Study: **Facilities (Enterprise Development, Sponsorship & Privatization)**
  - **SPR-4448,** Central HMA Acceptance Lab Process Improvement Implementation Plan
  - **Damage Wise** Program Implementation **(ERIN, August 2019)**
  - Advanced **Pavement Training** for District and CO Pavement Engineers
  - **UAS Crash Scene Mapping Workshop at ACR – *September 2019***
  - **Salt Calibration & Liquid Routes Spreaders Calibration.**
  - INDOT **EVOLVE,** Purdue/JTRP Events, **EVOLVE Field Trip to Thornton Stone Quarry (October 2019)**
  - INDOT staff serving as **business owners/SAC** with faculty, practitioners, other DOT staff. INDOT staff indicates positive professional development from SAC engagement

○ Other Program Impact Areas

• Every Day Counts, EDC, (National IMPACT select examples)

- Partnership with FHWA in EDC Initiatives
- Participated in EDC 6 Virtual Summit and submitted 10 innovations for Indiana.
- Facilitated **8 Innovations in EDC 6** (INDOT advanced 4 for Demo 1 for Development, 1 for Assessment Stage, 1 institutionalized already and 1 not advanced).
- Facilitated **10 Innovations in EDC 5** (INDOT advanced 5, 4 institutionalized already and 1 not advanced). LTAP support for 2 of these institutionalized.
- Participated in National STIC Meetings.
- **INDOT EDC 5 Project Bundling Webinar**
- **INDIANA DOT DEVELOPS MODELS FOR SELECTING THE BEST PROJECTS TO BUNDLE – FHWA Innovator**
- **$580K STIC Incentives** leveraging 5 INDOT studies.
- **Participated in National Pooled Fund Studies, PFS.** INDOT participated in the PFS “Effect on capacity of freeways, 2-lane highways, arterial streets, and intersections of connected automated autonomous, vehicles; and on expected adoption & penetration rates”



- **Engagement & Networking (select examples)**

  - JTRP EC Meeting and Demonstrations at Purdue **ACRE facility,** August 2019
  - **LiDAR and Photogrammetry** for Construction (**DC Roland Fegan Campus Visit**)
  - **Innovation Division & Todd May site visit to INDOT R&D**
  - **Crawfordsville Leadership Visit** to INDOT R&D August, 2019.
  - **SPD/HR and Safety Director site visit** (October 3, 2019)
  - **JTRP Workshop, Poster Session and Board Meeting at IGCS, February 2020**
  - Participating & Winning the second annual Governor's State Employees' 3**-on-3 Basketball Tournament**. (Inside INDOT, October 2019)
  - INDOT & LTAP demos for **calibration for liquid routes**.
  - **TRB Annual meeting** (presentations, papers, posters)
  - **NCHRP, TRB, AASHTO** Committees membership.

UAS Crash Scene Mapping Workshop at ACRE

September 26, 2019

- **State and National Recognitions (select examples)**

  - **ERIN articles, Inside INDOT newsletter articles**

    - **Prototype Trailer** Puts Us Ahead in Innovation (Inside INDOT article July 2019)
    - **Crash Prediction Module** Aids Our Design Teams (Inside INDOT article, September 2019)
    - **INDOT Uses New Technology to Design Safer Roadways** – September 2019
    - **Friction Tests** to Monitor **District Scrub-Sealing Process with Different Emulsions – October 2019**
    - Special **raised pavement markers** (RPMs), will be installed along U.S. 20 pavement.
    - Late Three-Pointer Lifts INDOT to 3-on-3 Basketball Title – October 2019

- New **LED Lights** Brighten up INDOT's Roadways, One District at a Time. (December 2019)
- **Innovations Winners** – January 2020
- INDOT Is Ahead of the Curve on Winding Roads – **High Friction Materials in horizontal curves** – January 2020.
- **INDOT Experts Lead Technical Sessions at Road School – March 2020**
- **Inside Indiana Business TV interview & ASCE Game Changing Award – Sensors in Concrete Pavement** https://www.youtube.com/watch?v=6HpaCVGeSHc&t=96s
- **Friction Testing – I 465 ramp fire** – April 2020.
- INDOT Smartly Explores the Use of **Unmanned Aircraft**.
- **Damage-Wise** enables INDOT to seek reimbursement for repair costs from vehicle drivers or their insurance.
- **Damage to State Property Team Honors State Troopers**
- **INDOT's Research Program Has Huge ROI**
- **INDOT's Research Program Becomes Ultra-Popular**
- INDOT is a significant partner in a new **innovation hub (for Connected and Autonomous** Transportation Technologies) that is receiving national attention
- District Tests **friction of surfaces sealed with Scrub-Sealing** Process employing Different Emulsions
- Presentation at the AASHTO Maintenance Committee Summer Meeting: **"Leveraging Telematics and Weather Data to Study the Productivity of Roadside Mowers"** (July 2019)

Inside INDOT

INDOT's Research Program Continues to Have a Huge Return on Investment

The INDOT Research Program is an established state DOT Research Program that partners with INDOT staff, the Federal Highway Administration, academia, and industry to address Indiana's transportation needs and challenges.

The program has realized significant achievements over the years, and each year provides two reports highlighting the quantitative and qualitative benefits delivered by the program. The first is the INDOT Research Program Return on Investment (ROI) that quantifies the cost savings to customers (such as mobility user costs and safety) and to INDOT (agency savings). The second is the Research Program IMPACT Report that describes the qualitative benefits derived from the program.

These reports provide a comprehensive snapshot of the many benefits from the INDOT Research Program. Given below is the three years moving average of the ROI.

- 88 Completed Projects (Three Years Moving Average)

Agency B/C ratio 21:1
non-agency B/C ratio 21:1
Total B/C Ratio 42:1

Quantifiable Benefits Projects	Qualitative Benefits Projects	Projects Not Successfully Implemented
18	65	5

Many state DOTs have modeled their state research programs after the Indiana program. Indiana's program has also received national recognition for its impact on national transportation issues.

"The state of Indiana spent $3.9 million on research projects in 2017 and they report that just five of those research projects saved the state millions," said Brian Ness, director of the Idaho Transportation Department, in his written testimony before the U.S. House subcommittee on research and technology in July 2019. "What a great return on investment, saving $46 for every $1 spent on research!"

- **TRB Awards and high-profile articles**

  - Deriving Operational Traffic Signal Performance Measures from Vehicle Trajectory Data – **Best Paper Award January 2021**
  - "Using Connected Vehicle Data to Reassess Dilemma Zone Performance of Heavy Vehicles" winner of the **TRB Best Paper Award** – January 2020
  - "Ontology-Based Knowledge Management System for **Digital Highway Construction Inspection**," winner of the TRB, K. B. Woods Award.
  - "**Bundling Bridge and Other Highway Projects: Patterns and Policies**," Best paper award from TRB (D. Grant Mickle Award)
  - Best Paper award for TRB "**Evaluating Construction work zone Employing LiDAR".**
  - **Concrete Sensor Research**, Inside Indiana Business TV interview with Prof. Luna Lu (December 12, 2019)
  - August 28, 2019 News Release: **Science to reveal how long highway construction should actually take**

- **Miscellaneous Research News & high profile articles**

  - **Engineering News Record Names INDOT "Owner of the Year" Commissioner email**
  - **<u>These 5 states are in the best shape in 2019</u> – Commissioner email**
  - **INDIANA DOT DEVELOPS MODELS FOR SELECTING THE BEST PROJECTS TO BUNDLE – FHWA Innovator**
  - **Mapping & Documenting Roadway crash scenes**.
  - Development of an **Intelligent Snowplow Truck**, Presentation at the AASHTO Maintenance Committee Summer Meeting
  - State DOT Executives Highlight Research Funding Need at **House Hearing**
  - These 5 states are in the best shape in 2019 (**Indiana #1**)
  - Top 10 states with the best infrastructure in America (**Indiana #2**).

On-Ramp to Innovation
every day counts

INDIANA DOT DEVELOPS MODELS FOR SELECTING THE BEST PROJECTS TO BUNDLE

PROJECT CASE STUDY

○ Forensic Investigations and Specialized Testing Programs (select examples)

- Forensic capabilities & data driven decision-making capabilities, direct result of research program
- **Failed Materials Committee Looks After INDOT's Best Interests –** January 2021
- **Seymour District SR 129 FWD Testing & Analysis** – May 2020
- Newsletter story on I-465 ramp fire Friction Testing. – Erin April 2020.
- **INDOT R&D personnel collected GPR data at the Purdue Airport.**
- **Sinkhole Prompts District to Rise to the Occasion.**
- R&D was requested to employ ground-penetrating radar (GPR) vehicle to investigate eastbound and westbound I-265.
- **Greenfield District recognition for INDOT R&D testing efforts** on I-465, I-70, and I-65 testing in Marion County.

- **New Trailer Helps INDOT Get Ahead in Innovation**
- **NDT of Bridge Decks** – Impact Echo Emerging Technology – Crawfordsville District – Results & Implications
- **Friction and Texture Quality testing** on crack sealing material to ensure the material met national specifications on the roads with the highest number of complaints of low skid resistance.
- Identification of **bridges with low friction numbers**
- **Telematics and Utilization Analytics for INDOT Mowing Operations**
- **MCAR: Marion County Asset Recovery Program,** specialized testing support
- **Dynatest RAPTOR demo** (continuous deflection testing equipment) (October 23, 2019)

○ Program Metrics & Venues for Continuous Improvement

➢ **Eight Objective Performance measures for INDOT Research Program;**

#	Description	Goal
1	% Final Report submitted on time of Active Projects	>90%
2	% Successful Implementation of completed projects in a FY (KPI 6)	>90%
3	Return on Investment in a FY (B/C)	> 2
4	Percent Customer Satisfaction Score Meeting or Exceeding Expectations	> 90%
5	# & Percent of Time Extensions	Specifying a Goal
6	% progress reports submitted on time	100%
7	% Draft Final Report submitted on time	> 90%
8	% Successful Communications	> 90%

- Linkage of **INDOT Strategic Plan** to User's Manual, Summary of Impact & ROI reports, Customer Service Surveys, Implementation Plans and Template Research Need Statements.
- **Mapping research projects to INDOT Strategic Plan**.
- Collaborate with the new **Innovation Office** for opportunities, to share current innovations and how the two offices can support each other's mission as in EDC National Summit.
- Explore new methods to **communicate research results and innovations using online webinars** (mirror the TRB webinar format).
- FY 2021 February 27 Show Case & Peer Group meetings, focusing on peer groups to identify research needs on an ongoing basis. **FY 2022 Prioritized needs and Ideas was held on February 25**. Faculty Liaisons were engaged in Focus Groups.
- Title VI impact/compliance training.
- FY 2021, 203 research needs submitted, 41 research projects funded, 18 projects completed thus far, 90 active projects.

- FY 2020, 236 research need submitted, 45 research projects funded, 40 projects completed.
- Smartsheet tracking software used for project management (active projects, needs identified, tracking implementation status).
- Customer Satisfaction Performance Measures, reported to Executive Board
- Summary of IMPACT Report, Return on Investment (ROI), Conversion Rate.
- User manual update.

○ Resources and Links

- **Indiana Government**
- www.in.gov

- **Indiana Department of Transportation, INDOT**
- www.in.gov/indot

- **INDOT Research & Development Division Contact Information**
- www.in.gov/indot/2700.htm
- Submission of Research Needs & Ideas (www.in.gov/indot/2404.htm)
- Innovative Research Needs & Ideas (www.in.gov/indot/2404.htm)
- Research Program IMPACT Report (www.in.gov/indot/2404.htm)
- Research Program Return on Investment (www.in.gov/indot/2404.htm)

- **Research Program User's Manual** (https://engineering.purdue.edu/JTRP/files/UsersManual_20191201.pdf)

- **Joint Transportation Research Program**
- **https://engineering.purdue.edu/JTRP**

- **Innovation Office and Submission Link (only through the intranet)**
  https://ingov.sharepoint.com/sites/INDOTIntranet/SitePages/Innovation- at-INDOT(2).aspx

- **Testimony to the U.S. House of Representatives Committee on Science, Space, and Technology, Subcommittee on Research and Technology: "Bumper to Bumper: The Need for a National Surface Transportation Agenda", July 11, 2019**
  https://science.house.gov/imo/media/doc/Ness%20Testimony.pdf